



US005729663A

United States Patent [19]

Lin et al.

[11] Patent Number: 5,729,663

[45] Date of Patent: Mar. 17, 1998

[54] METHOD AND APPARATUS FOR GRAY SCREENING

5,542,029 7/1996 Karlsson 358/456
5,555,102 9/1996 Dalton 358/456

[75] Inventors: Ying-wei Lin, Penfield; Leon C. Williams, Walworth, both of N.Y.

[73] Assignee: Xerox Corporation, Stamford, Conn.

[21] Appl. No.: 569,036

[22] Filed: Dec. 7, 1995

[51] Int. Cl.⁶ H04N 1/40

[52] U.S. Cl. 395/109; 358/456; 358/465

[58] Field of Search 358/456, 466,
358/465, 460, 457, 459, 534-536, 455;
382/270; 395/106, 109, 117, 162, 164

[56] References Cited

U.S. PATENT DOCUMENTS

4,544,264	10/1985	Bassetti et al.	355/208
4,625,222	11/1986	Bassetti et al.	358/300
4,860,026	8/1989	Matsumoto et al.	358/298
5,077,615	12/1991	Tsuji	358/298
5,200,831	4/1993	Tai	358/298
5,204,753	4/1993	Tai	358/298
5,258,849	11/1993	Tai et al.	358/298
5,258,850	11/1993	Tai	358/298
5,260,807	11/1993	Tai	358/456
5,274,472	12/1993	Williams	358/455
5,289,294	2/1994	Fujisawa	358/461
5,291,311	3/1994	Miller	358/456
5,333,260	7/1994	Ulichney	395/162
5,333,262	7/1994	Ulichney	395/164
5,359,431	10/1994	Ng	358/457
5,444,551	8/1995	Miller et al.	358/456
5,455,681	10/1995	Ng	358/298
5,469,516	11/1995	Kerz	358/456
5,488,487	1/1996	Ojima et al.	358/456
5,495,345	2/1996	Ulichney	358/457

OTHER PUBLICATIONS

Xerox Disclosure Journal; "A Partial Dot Algorithm For Multi-Level Pixel Halftone Cells"; vol. 14 No. 4 Jul./Aug. 1989, pp. 175-176; Thomas Henderson et al.

J. C. Stoffel; "A Survey of Electronic Techniques for Pictorial Image Reproduction"; IEEE Transactions on Communications, vol. COM-29.12, Dec. 1991.

Paul A. Delabastita; "Multilevel Halftoning"; Is & T's Fourth Technical Symposium on Prepress, Proofing & Printing (1995).

P. Pirsch; A. N. Netravali; "Transmission of Gray Level Images by Multilevel Dither Techniques"; pp. 31-44.

Primary Examiner—Scott A. Rogers

Assistant Examiner—Fan Lee

Attorney, Agent, or Firm—Duane C. Basch

[57] ABSTRACT

The present invention is a method and apparatus for generating N-bit per pixel output signals in response to M-bit per pixel image input signals, where M is greater than N. The invention employs a halftone cell threshold memory that stores a single threshold for each cell element. During real-time processing of the video image signals, multiple thresholds are calculated based upon the stored thresholds, and the image signals are compared to the thresholds. The threshold calculation process is simplified by using equally spaced constants and any desired variation from the resulting equally spaced thresholds is accomplished through a remapping of the video image signals using a look-up table. The output of the plurality of comparisons carried out for each halftone cell element is then encoded to produce a digital gray-scale output signal.

20 Claims, 6 Drawing Sheets

